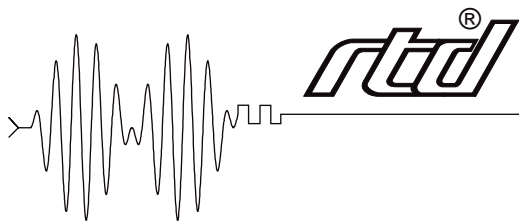


SS4/SS8

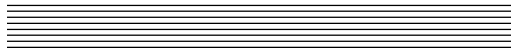
Simultaneous Sample-and-Hold Board

User's Manual



Real Time Devices USA, Inc.

"Accessing the Analog World" ■



SS4/SS8



User's Manual



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INTRODUCTION

The SS4 and SS8 simultaneous sample-and-hold boards sample data from multiple channels with a channel-to-channel skew time of less than 1 nanosecond. The SS4 and SS8 feature:

- Sampling on up to 4 (SS4) or 8 (SS8) input channels simultaneously,
- Less than 1 nanosecond channel-to-channel skew,
- Acquisition time of 1 microsecond,
- Differential or single-ended inputs,
- Channel independent selectable gains of 1, 2, 4 & 8 (or 1, 10, 100 & 1000),
- On-board screw terminals for easy wiring.

What Comes With Your Board

You receive the following items in your SS4/SS8 package:

- SS4 four-channel or SS8 eight-channel simultaneous sample-and-hold board
- User's manual

If any item is missing or damaged, please call Real Time Devices' Customer Service Department at (814) 234-8087. If you require service outside the U.S., contact your local distributor.

In addition to the items included in your SS4/SS8 package, Real Time Devices offers a full line of data acquisition boards and board accessories. Key accessories for the SS4/SS8 include the TB50 terminal board and XB50 prototype/terminal board which can be connected to the daisy chain connector for prototype development and easy signal access, and the DWK-1 and DWK-2 discrete wire kits for connecting 40-pin interface boards to the 50-pin SS4 or SS8 board.

Using This Manual

This manual is intended to help you get your new board running quickly, while also providing enough detail about the board and its functions so that you can enjoy maximum use of its features even in the most complex applications. We assume that you already have an understanding of data acquisition principles and that you can provide the software necessary to control the SS4 or SS8 board.

When You Need Help

This documentation package should provide enough information for you to achieve your desired results. If you have any problems using this board, contact our Technical Support Department, (814) 234-8087, during regular business hours, eastern standard time or eastern daylight time, or send a FAX requesting assistance to (814) 234-5218. When sending a FAX request, please include your company's name and address, your name, your telephone number, and a brief description of the problem.

CHAPTER 1

BOARD SETTINGS

The SS4/SS8 board has jumper settings you can change if necessary for your application. The factory settings are listed and shown on a diagram in the beginning of this chapter. Should you need to change these settings, use these easy-to-follow instructions.

Board Settings

The SS4/SS8 board has jumper settings you can change if necessary for your application. The factory settings are listed in this section and shown on Figure 1-1 below. Should you need to change these settings, use these easy-to-follow instructions.

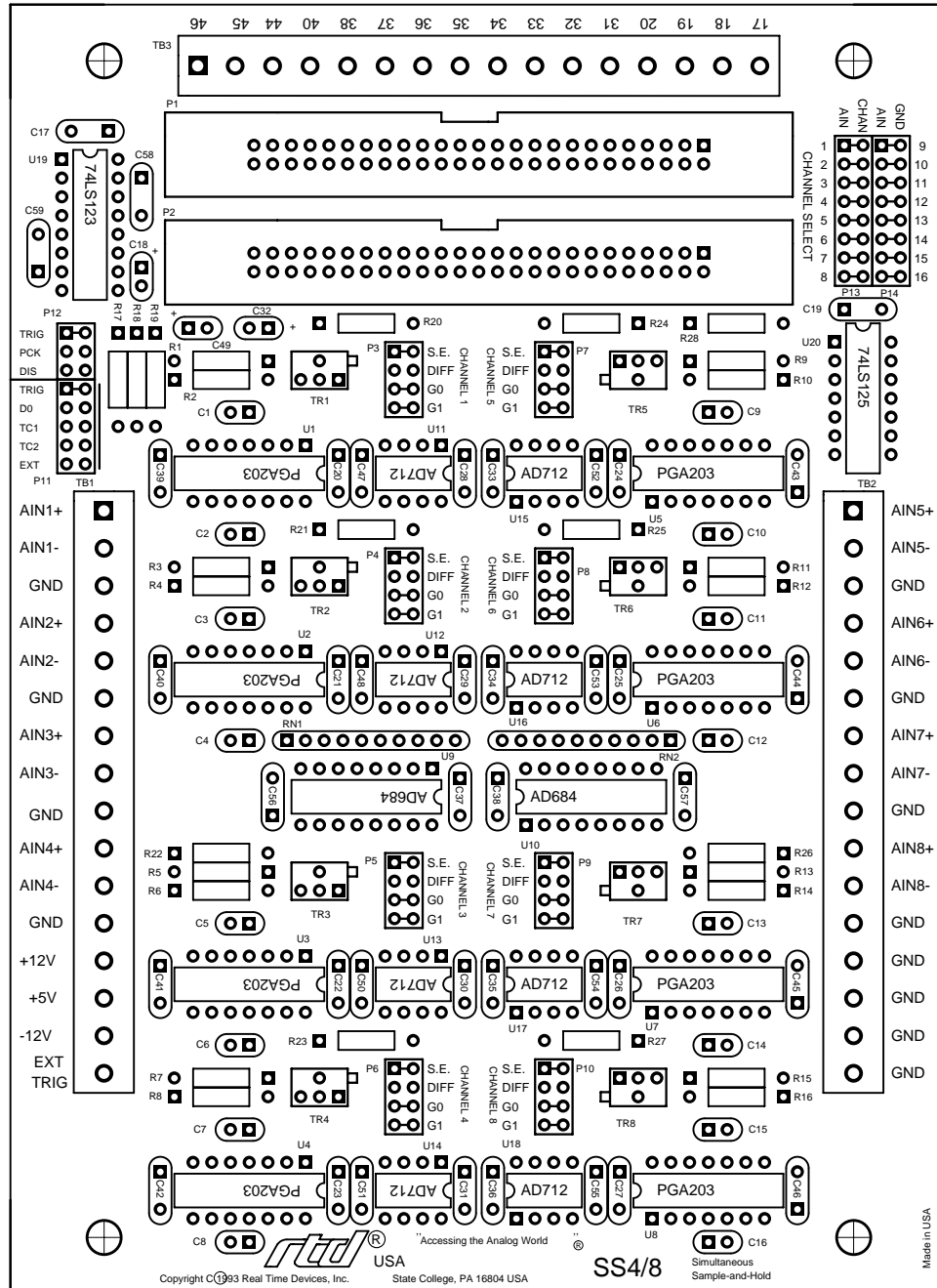


Fig. 1-1 — SS4/SS8 Board Layout

P3 through P10 — Single-Ended/Differential & Gain (Factory Settings: Single-Ended; Gain = 1)

Header connectors P3 through P10, shown in Figure 1-2, let you select the input type and gain for each channel. The top two sets of pins are used to select single-ended or differential input type. When the differential input type is selected, the negative input signal (AIN-) is grounded through a 10 kilohm resistor. When the single-ended input type is jumpered, this resistor is shorted. The bottom two sets of pins, G0 and G1, let you select one of four input gain settings for each channel. These gains are in addition to the gain available on the A/D interface board you are using with the SS4/SS8. The table below shows the jumper configuration for each gain setting. Boards are shipped with gain amplifiers providing gains of 1, 2, 4, and 8 unless optional 1, 10, 100, and 1000 gain amplifiers were requested when ordering the board.

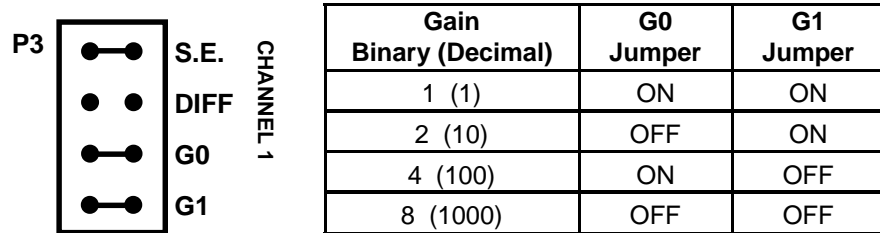


Fig. 1-2 — Input Type & Gain Jumpers, P3 through P10

P11 — A/D Sample Trigger (Factory Setting: TRIG)

P11, shown in Figure 1-3, provides five ways to trigger a sample on each channel of the SS4/SS8. One or more of these triggering methods can be used with any Real Time Devices' A/D interface board. Figure 1-4 shows a block diagram of SS4/SS8, with the triggering methods identified.

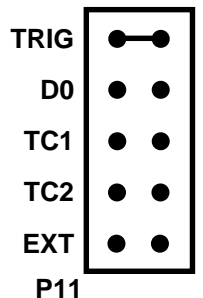


Fig. 1-3 — A/D Sample Trigger Jumper, P11

TRIG — This line connects to pin 43 on the I/O connector, the TRIGGER OUT pin on the DataMaster series boards. The A/D board must have the TRIGGER OUT at pin 43 on its I/O connector, and must have an SS/NORM header connector on board with the jumper placed in the SS position. If your A/D board doesn't not have these two features, then you cannot use this line to trigger a sample. The 3000, 3100, 3110, 3700, and 3710 series have these features. When properly connected, a pulse on this line will trigger a sample.

D0 — This line is connected to pin 38 on the I/O connector, which is a digital I/O line (labeled PC0 or DOUT0) on all A/D boards with 50-pin I/O connectors. This includes DataMaster, Advanced Industrial Control, and PC/104 dataModules. A discrete wire kit can be used to hard-wire a digital output line from a 40-pin I/O connector to pin 38 on the SS board to accommodate boards with 40-pin connectors. When the digital line is set up as a Mode 0 output (for 8255 based I/O lines) and pulsed (taken from low to high and then back to low), the SS board samples all channels.

TC1 and TC2 — Either of these lines can be used to take a timed sample, triggering a sample whenever the counter's count reaches 0. TC1 is connected to pin 42 on the I/O connector, T/C OUT 1, which is the output of the

pacemaker clock on many boards. TC2 is connected to pin 44, T/C OUT 2, on the I/O connector, and can be used for timed sampling intervals on many boards. Most 50-pin A/D boards have these outputs available. Check the I/O pin assignments to confirm availability on your board. A discrete wire kit can be used to hard-wire a digital output line from a 40-pin I/O connector to pin 42 or 44 on the SS board to accommodate boards with 40-pin connectors.

EXT — This line is connected to the EXT TRIG signal available at terminal 16 on TB1 on the SS board. An external trigger can be used through this connection to trigger samples. EXT is a TTL level line which must be pulsed high for a duration of 100 nanoseconds to 1 microsecond in order to trigger a sample.

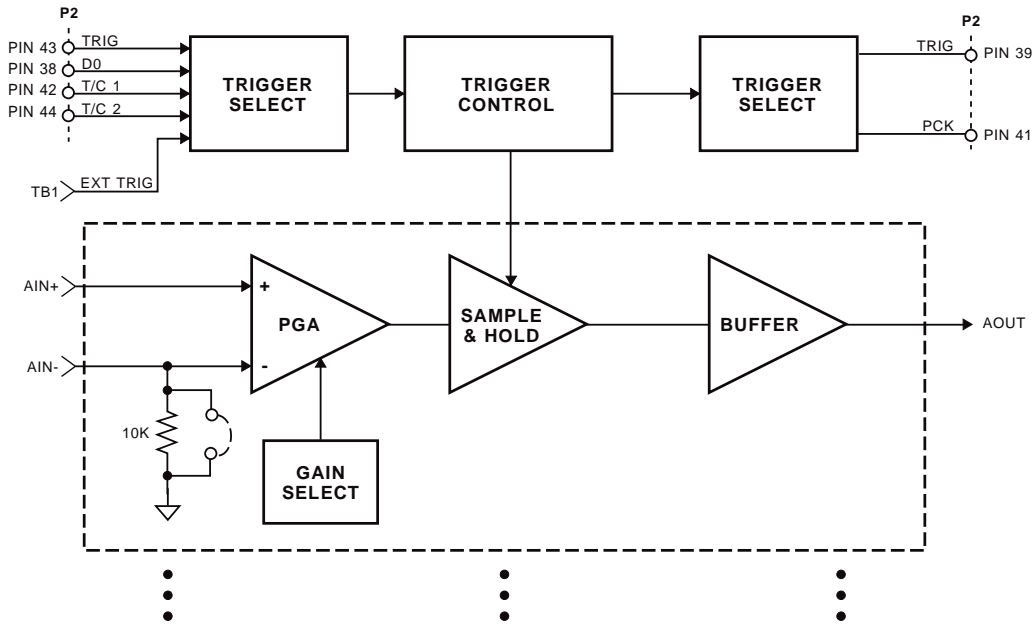


Fig. 1-4 — SS4/SS8 Block Diagram

P12 — Sample Done (Factory Setting: TRIG)

When the SS board has completed the sample, P12, shown in Figure 1-5, can be used to tell the A/D board that sampling is done. On some boards, this information can be used to immediately start A/D conversion of all the sampled channels.

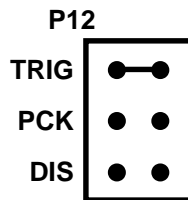


Fig. 1-5 — Sample Done Jumper, P12

TRIG — This line is connected to the TRIGGER INPUT, pin 39 on the A/D board's I/O connector. When the SS board has completed sampling, this line is pulsed. The pulse is then fed to the TRIGGER INPUT on the A/D board, where, when the board is configured for burst mode, it triggers an A/D conversion of all the sampled channels. This burst mode triggering is supported by the DataMaster, Advanced Industrial Control, and dataModule 400 series.

PCK — This line is connected to pin 41, where it feeds back into the pacemaker clock line on the A/D board. This signal can be used to trigger A/D conversions after the SS board has completed sampling on the 3110 DataMaster boards only.

DIS — This position disables a feedback signal. When set to this position, a sample is taken, and a software delay of at least 1 microsecond is inserted before starting A/D conversions and reading data. This setting is compatible with Low Cost Industrial Control boards with 40-pin I/O connectors.

P13 and P14 — A/D Converter Board Channel Select (Factory Setting: Differential Input Channels 1-8)

Since there are no multiplexers on the SS board, each input must be assigned to an input channel on the A/D board. P13 and P14 are used to select which analog input channel on your A/D converter board you connect to the each channel on the SS board. These connectors accommodate A/D converter boards with up to 16 single-ended or eight differential channels.

For Single-Ended Input Channels: When you connect the SS4/SS8 to an A/D converter board in the single-ended mode, each channel on the SS board can be connected to one of two channels on the A/D board. Channel 1 on the SS board can be connected to channel 1 or 9 on the A/D board, channel 2 on the SS board can be connected to channel 2 or 10 on the A/D board, and so on. This allows you to daisy chain two SS boards, routing one set on inputs to channels 1-8 and the other set of inputs to channels 9-16 on the A/D board. Figure 1-6a shows eight SS channels connected to A/D board channels 1-8, and Figure 1-6b shows eight SS channels connected to A/D board channels 9-16.

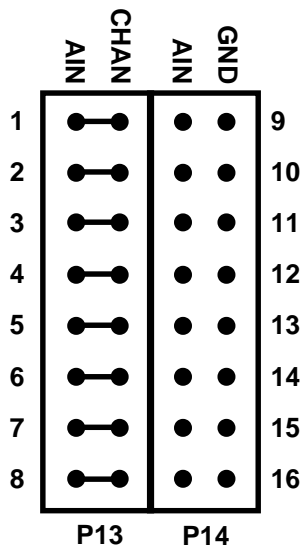


Fig. 1-6a — Channels 1-8

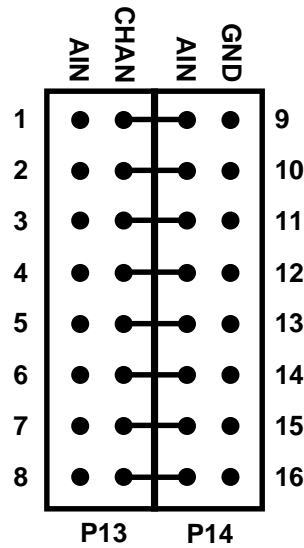


Fig. 1-6a — Channels 9-16

Fig. 1-6 — Single-Ended Input Channel Select Jumpers, P13 and P14

For Differential Input Channels: When you connect the SS4/SS8 to an A/D converter board in the differential mode, two jumpers must be installed across each input channel used. One jumper is installed on P13 across AIN and CHAN, and one jumper is installed in P14 across AIN and GND. Figure 1-7 shows channels 1 through 4 connected to channels 1 through 4 on the A/D board as differential input channels.

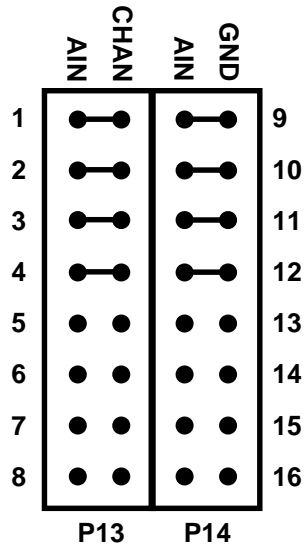


Fig. 1-7 — Differential Input Channel Select Jumpers, P13 and P14

CHAPTER 2

BOARD CONNECTIONS

This chapter tells you step-by-step how to connect the SS4/SS8 board to your A/D converter board and to your external signal sources.

Connecting to the A/D Converter Board

Connecting to a 50-pin A/D Converter Board

Figure 2-1 shows the SS4/SS8's P1 I/O connector pinout, with all of the pins used by the SS board labeled. The SS4/SS8 is pin-for-pin compatible with Real Time Devices' 50-pin I/O connector boards. These include the 1200, 1700, 2200, 2700, 3000, 3100, 3110, 3700, 3710, and dataModule™ series boards. For these boards, all of the unlabeled pins on the SS4/SS8 carry the same signal found at the I/O connector of the A/D converter board you are using.

If you want to access other signals on your A/D converter board, such as digital I/O or timer/counters, you can connect to the 16 signals available on TB3 at the top of the SS board, shown in Figure 2-2. This terminal strip is labeled with the pin numbers brought out to it from the 50-pin connector. To find the signals available on these pins, refer to the A/D converter board's pinout included in the board's manual.

To expand the number of input channels to 16, you can use the daisy chain connector on the SS board, P2. The signals at this connector are identical to the pinout of your 50-pin A/D converter board. You can connect to another SS board, or to a TB50 or XB50 breakout board to easily access all of the digital I/O and timer/counter signals. Our technical staff will gladly help you select the accessories you need for your application.

WARNING! If you connect more than one SS board to an A/D converter board, be sure that you select different A/D converter board channels on each SS board used (header connectors P13 and P14 on the SS4/SS8). If you try to connect more than one input channel to the same A/D input channel, damage to the boards and data acquisition system can result!

Connecting to a 40-pin A/D Converter Board

The SS4/SS8 can be adapted for use with Real Time Devices' 40-pin A/D converter boards by making I/O connections using an RTD Discrete Wire Kit. Available with single or twisted pair wiring, this kit is designed so that you can mate connectors with otherwise incompatible pinouts. Using Figure 2-1 and the pinout diagram for your A/D converter board, you can make the appropriate connections.

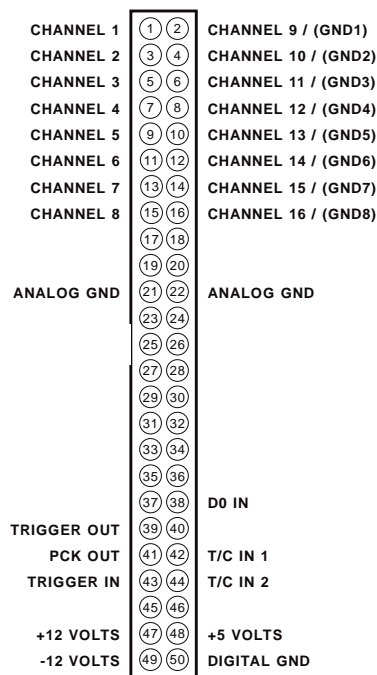


Fig. 2-1 — P1 I/O Connector Pin Assignments

Connecting to the Signal Sources

Figure 2-2 shows TB1 and TB2, where the analog input signals are connected. These 16-terminal miniature screw terminal strips let you easily connect and disconnect analog inputs to the board. Up to eight signal sources can be connected to the SS8 and up to four signal sources can be connected to the SS4. Ground and power terminals and an EXT TRIG terminal are provided for your convenience.

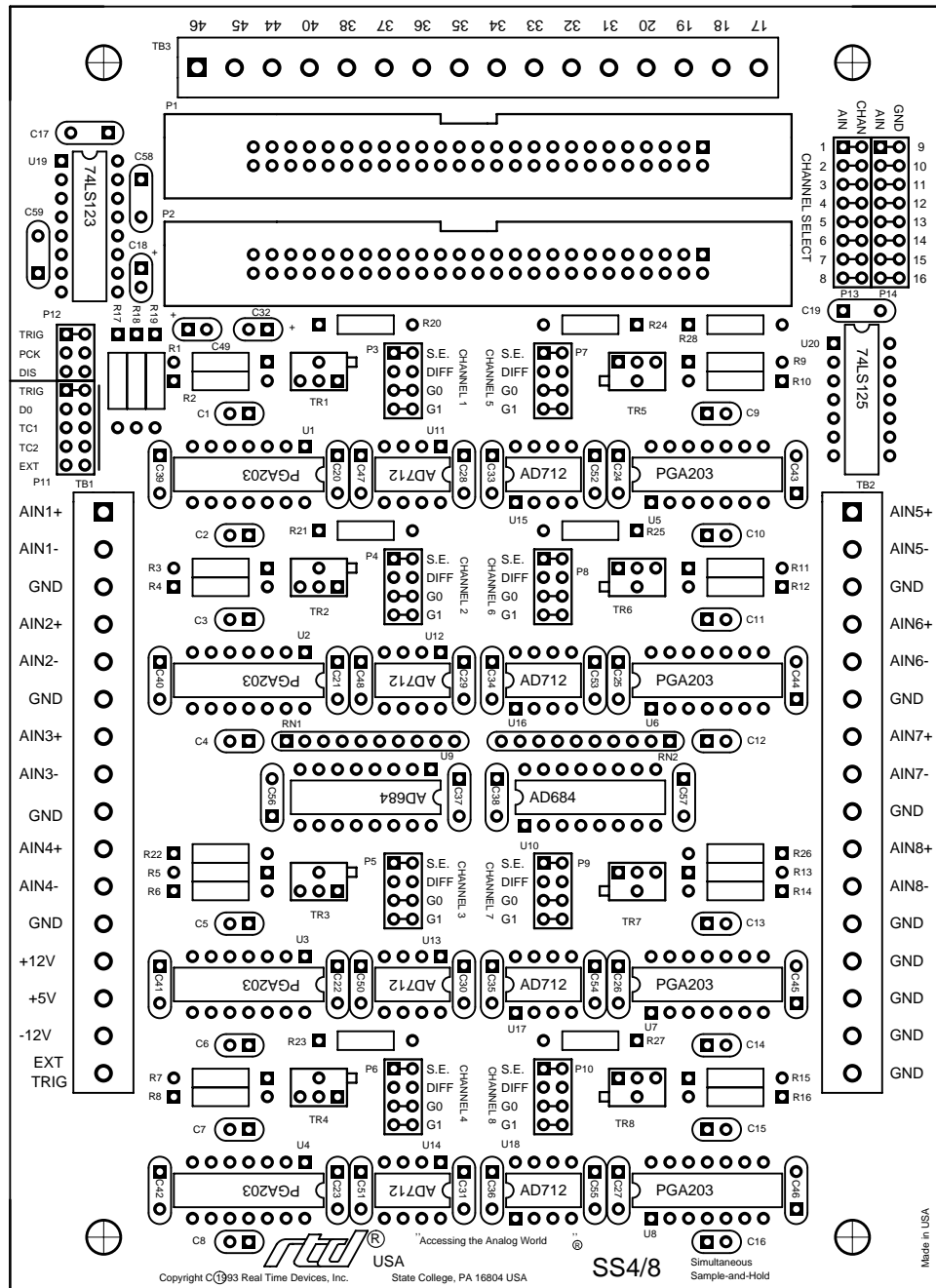


Fig. 2-2 — SS4/SS8 Board Layout

Connecting Single-Ended Analog Inputs

For single-ended sources, set the jumper to S.E. and connect the high side of the signal source to the selected AIN+ terminal and the low side to the AIN- terminal. Figure 2-3 shows this type of connection..

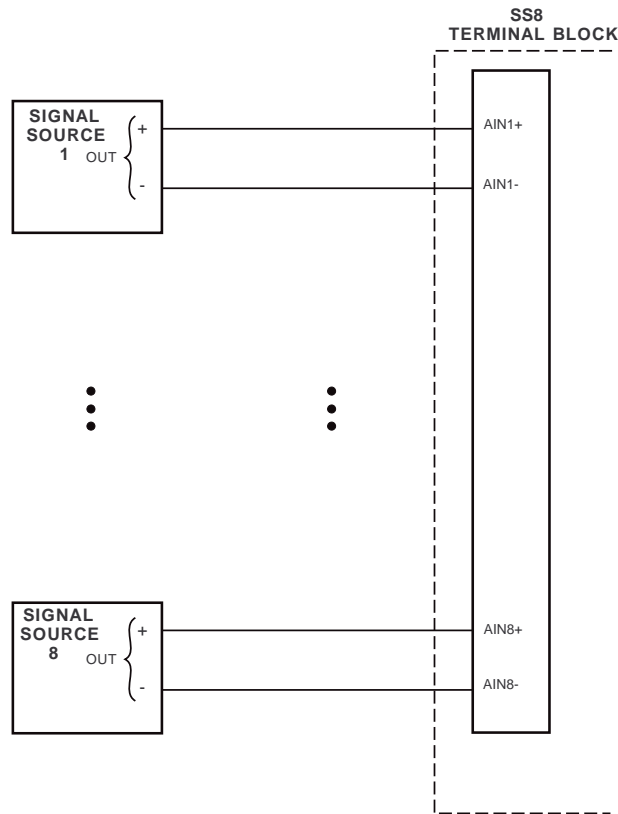


Fig. 2-3 — Single-ended Input Connections

Connecting Differential Analog Inputs

For differential signal sources, make sure the jumper is set to DIFF. When operating in the differential mode, twisted pair cable is recommended to reduce the effects of magnetic coupling at the inputs. Your signal source may or may not have a separate ground reference. In either case, the ground connection on the SS board should be made through the 10 kilohm resistor. This resistor is connected when you install the jumper on DIFF on P3 through P10. This connection assures that common mode voltages induced by the input source are not converted to normal mode voltages. Figure 2-4 shows how to connect the input if you do not have a ground reference from the signal source, and Figure 2-5 shows you how to make the connections with a ground reference from the signal source.

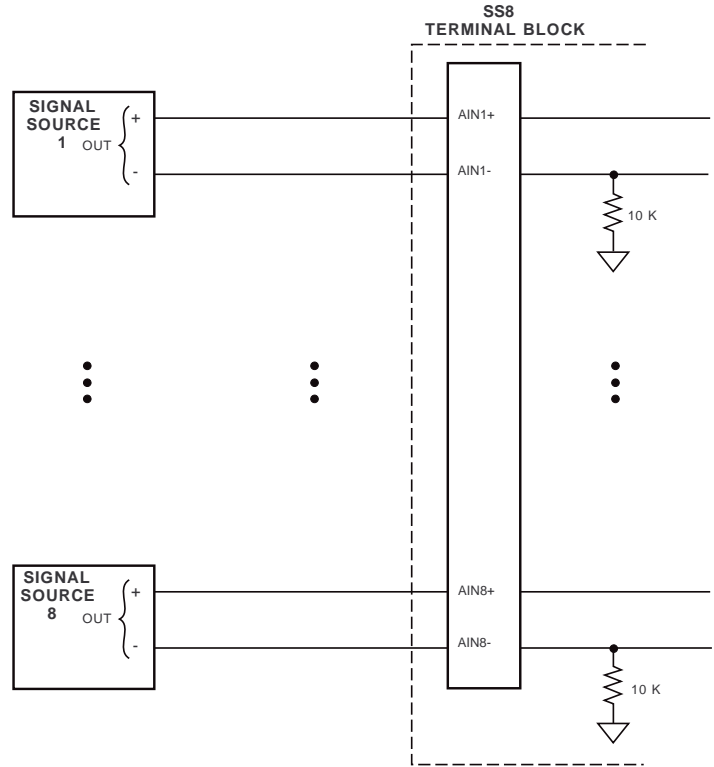


Fig. 2-4 — Differential Input Connections, No Ground Reference

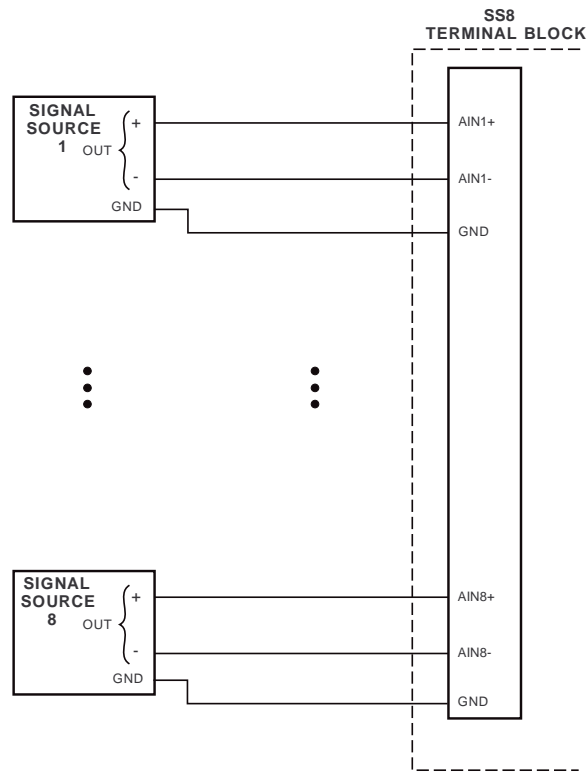


Fig. 2-5 — Differential Input Connections, Ground Reference

CHAPTER 3

BOARD OPERATION

This chapter describes the features of the SS4/SS8 and board operation.

The SS4/SS8 simultaneous sample-and-hold board allows you to acquire data from several input sources at the same time. Most data acquisition boards have a single sample-and-hold amplifier after the multiplexer. For multiple channels, each channel is sampled in sequence at a different point in time. Figure 3-1 shows four input channels sampling a 12.5 kHz sine wave once per every 5 microseconds in sequence using a data acquisition board with a multiplexer and single sample-and-hold amplifier. As you can see, when each channel samples the same waveform in sequence, the readings can be very different.

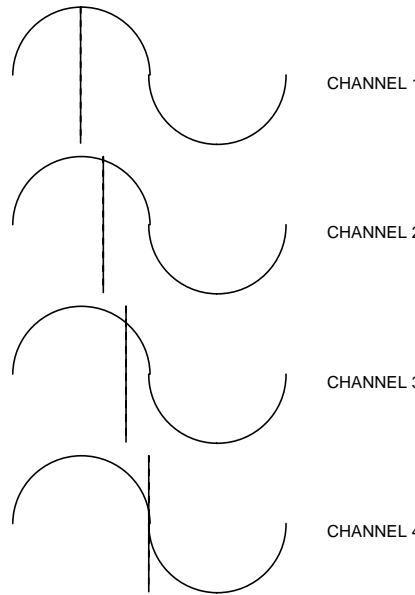


Fig. 3-1 — Channel-to-channel Skew, Multiplexed Sampling Without SS4/SS8

In some applications, the relationship between input channels as a function of time is critical. In these cases, the SS4/SS8 provides sampling with a channel-to-channel skew of less than 1 nanosecond, as shown in Figure 3-2. Here, the readings are taken so close together that the change in the waveform from channel 1 to channel 4 is undetectable.

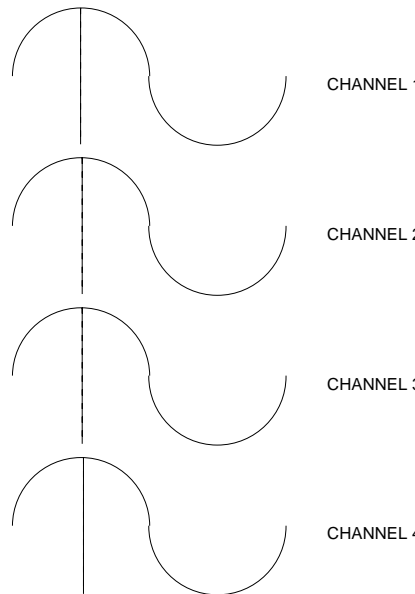


Fig. 3-2 — Channel-to-channel Skew, Multiplexed Sampling With SS4/SS8

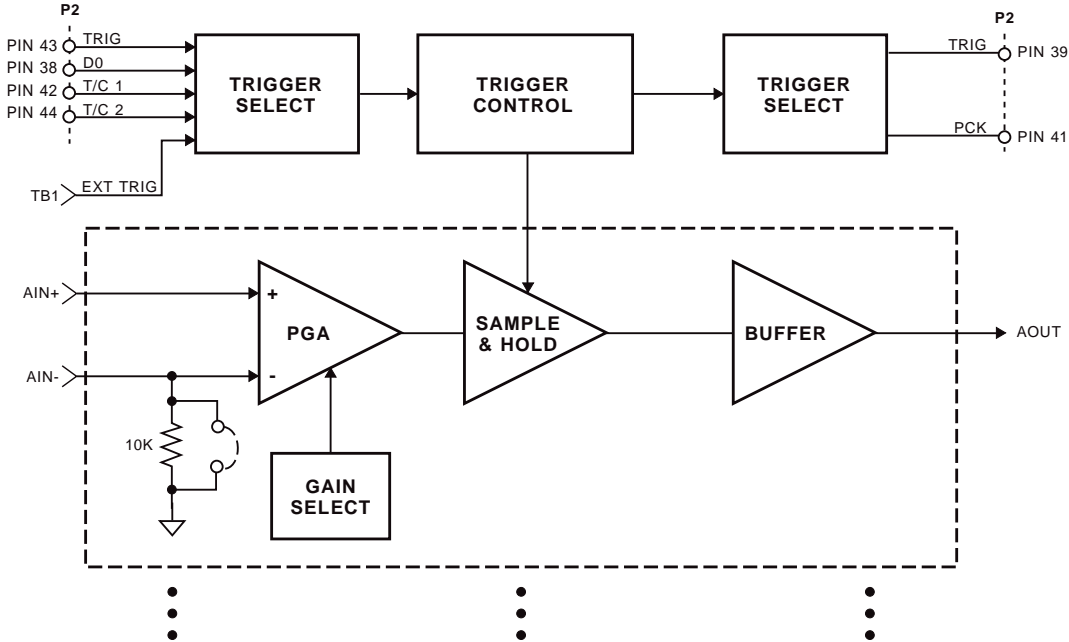


Fig. 3-3 — SS4/SS8 Block Diagram

Triggering

As described in Chapter 1, P11 and P12 discussions, you must apply a trigger in order to take a sample from each channel on the SS board. Figure 3-3 shows a block diagram of the SS board. Figure 3-4 shows the timing diagram. Any one of five signals can be used to trigger a sample of all channels. These are:

TRIG — This line connects to pin 43 on the I/O connector, the TRIGGER OUT pin on the DataMaster series boards. The A/D board must have the TRIGGER OUT at pin 43 on its I/O connector, and must have an SS/NORM header connector on board with the jumper placed in the SS position. If your A/D board doesn't have these two features, then you cannot use this line to trigger a sample. The 3000, 3100, 3110, 3700, and 3710 series have these features. When properly connected, a pulse on this line will trigger a sample.

D0 — This line is connected to pin 38 on the I/O connector, which is a digital I/O line (labeled PC0 or DOUT0) on all A/D boards with 50-pin I/O connectors. This includes DataMaster, Advanced Industrial Control, dataModules, and 50-pin Precision Integrating boards. A discrete wire kit can be used to hard-wire a digital output line from a 40-pin I/O connector to pin 38 on the SS board to accommodate boards with 40-pin connectors. When the digital line is set up as a Mode 0 output (for 8255 based I/O lines) and pulsed (taken from low to high and then back to low), the SS board samples all channels.

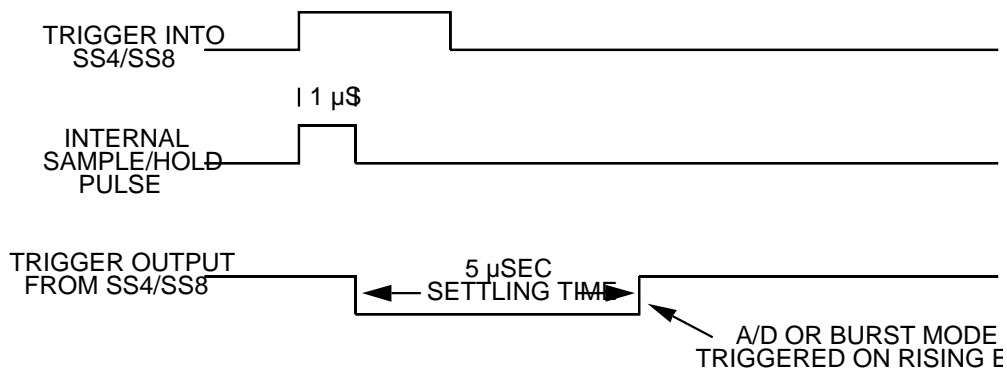


Fig. 3-4 — SS4/SS8 Timing Diagram

TC1 and TC2 — Either of these lines can be used to take a timed sample, triggering a sample whenever the counter's count reaches 0. TC1 is connected to pin 42 on the I/O connector, T/C OUT 1, which is the output of the pacer clock on many boards. TC2 is connected to pin 44, T/C OUT 2, on the I/O connector, and can be used for timed sampling intervals on many boards. Most 50-pin A/D boards have these outputs available. Check the I/O pin assignments to confirm availability on your board. A discrete wire kit can be used to hard-wire a digital output line from a 40-pin I/O connector to pin 42 or 44 on the SS board to accommodate boards with 40-pin connectors.

EXT — This line is connected to the EXT TRIG signal available at terminal 16 on TB1 on the SS board. An external trigger can be used through this connection to trigger samples. EXT is a TTL level line which must be pulsed high for a duration of 100 nanoseconds to 1 microsecond in order to trigger a sample.

After a sample of all channels is taken, a signal can be sent back to the A/D board to tell it that the sampling is complete by installing a jumper at the proper location on P12:

TRIG — This line is connected to the TRIGGER INPUT, pin 39 on the A/D board's I/O connector. When the SS board has completed sampling, this line is pulsed. The pulse is then fed to the TRIGGER INPUT on the A/D board, where, when the board is configured for burst mode, it triggers an A/D conversion of all the sampled channels. This burst mode triggering is supported by the DataMaster, Advanced Industrial Control, and dataModule 400 series. By using the TRIG line on both P11 and P12, you can continuously take and read data from each channel with a DataMaster board. Remember to set the SS/NORM jumper on the DataMaster board to the SS position. Other boards do not support this multiburst mode.

PCK — This line is connected to pin 41, where it feeds back into the pacer clock line on the A/D board. This signal can be used to trigger A/D conversions after the SS board has completed sampling on the 3110 DataMaster boards only.

The DIS position is provided so that you can disable the feedback signal for connection to boards without trigger input/output lines. When using this setting, make sure that your software program has a delay of at least 1 microsecond between the time the SS board is triggered to sample all channels and the time the A/D board begins to process the sampled data.

Droop Rate

When acquiring data using the SS board, note that the sampled input is captured by a capacitive circuit. Over time, the capacitor will lose its charge and the captured signal will no longer be accurate. The droop rate of the sample-and-hold amplifiers used on the SS board is specified at $.01 \mu\text{V}/\mu\text{s}$. When using a board with a 12-bit A/D converter, the LSB equals 2.4 millivolts. Therefore, it will take .24 seconds for the acquired signal to change by 1 bit, which is a change of 2.4 millivolts. This means that, for 12-bit conversions, you have almost 1/4 second to perform the A/D conversion after the sample has been taken before the data will be changed because of signal loss in the sample-and-hold circuit.

Output Voltage Range

The acquired signal which is sent to the A/D board for conversion can have a maximum range of -10 to +10 volts. However, if the A/D board's input range is different from this range (such as 0 to +5 volts), then the voltage level of the acquired signal must fall within the input voltage range of the A/D board for valid conversion.

Gain

Jumpers G0 and G1 on header connectors P3 through P10 allow you to individually set the gain for each channel. Gains of 1, 2, 4, and 8 are standard, with optional gains of 1, 10, 100, and 1000 available on request when ordering. The gain set by the SS board jumpers is independent of and additive to the gains available on the A/D board. Chapter 1 tells you how to configure these jumpers.

Offset Adjustment

TR1 through TR8 are used to make the offset adjustment for each channel's amplifier. All channels are factory adjusted for a gain of 1. It may be necessary to calibrate a channel when the gain is changed to a different value.

After you set the a channel's G0 and G1 jumpers for the desired gain, ground the input and adjust the associated trimpot so that the output is 0. The channel is now calibrated for the new gain setting.

APPENDIX A

SS4/SS8 SPECIFICATIONS

SS4/SS8 Characteristics Typical @ 25° C

Number of channels	SS4: 4 channels; SS8: 8 channels
Input type	single-ended or differential
Maximum input range	±12 volts
Acquisition time	1 µs, max
Aperture time	75 ps, max
Channel-to-channel aperture uncertainty	1 ns, max
Droop rate01 µV/µs
Gain	1, 2, 4, 8 or 1, 10, 100, 1000
Gain error (gain = 1)	±0.002%, typ
Non-linearity (gain = 1)	±0.012%, max
Analog output range	±10 volts, max
Input amplifier settling time	5 µs
Common mode input voltage	±10V, max

Current Requirements (SS8)

+12 volts	140 mA
-12 volts	140 mA
+5 volts	26 mA

Power Requirements

+5 volts, ±12 volts	From computer or external power supplies
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Connectors

Two 50-pin shrouded box headers

Screw Terminals

TB, TB2 & TB3 - 16-terminal
22-12 AWG wire

Size

6.875"L x 5.0"W (175mm x 127mm)

APPENDIX B

WARRANTY

LIMITED WARRANTY

Real Time Devices, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from REAL TIME DEVICES. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, REAL TIME DEVICES will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to REAL TIME DEVICES. All replaced parts and products become the property of REAL TIME DEVICES. **Before returning any product for repair, customers are required to contact the factory for an RMA number.**

THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by REAL TIME DEVICES, "acts of God" or other contingencies beyond the control of REAL TIME DEVICES), OR AS A RESULT OF SERVICE OR MODIFICATION BY ANYONE OTHER THAN REAL TIME DEVICES. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND REAL TIME DEVICES EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN. ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES FOR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL REAL TIME DEVICES BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES, INCLUDING ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS, OR OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

